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tation to the heterogeneity of the earth's surface, and is in sharp contrast to zonation as it is related to topographic asymmetry. A very interesting analysis is made of competition, which the author holds to be a physical factor in the last analysis.

This book is most difficult to review adequately, because of the great number of vital topics which are presented. The presentation is so logical and concise that a satisfactory review or summary would be little less than a verbatim reproduction of the work. The paper must be digested thoroughly from beginning to end by all who profess to be engaged in ecological research, and it should be studied by all botanists, especially those who think that ecology may not hope to deal with facts or have the logic or discipline of other lines of biology.—H. C. COWLES.

Leaf ecology.

HANS GIRG, who for a considerable time has been gathering data for such a work, has issued a somewhat elaborate volume on phyllobiology.² The aim of the author is to present the topic of the biology of the leaf, much as the biology of the flower has been presented in earlier works. Part I is devoted to a general consideration of leaf adaptations, especially those adaptations that may be called protective. Parts II and III make up the body of the volume, and present the biological classes or types of leaves.

Two general groups are recognized: the water and swamp leaf types of hydrophytes and halophytes, and the air leaf types of land plants. The former group has six subdivisions: the *Vallisneria* type adapted to currents, the *Myriophyllum* type adapted to standing water, the *Nymphaea* type of floating leaves, the *Isoetes* type, the *Lysimachia* (*Naumburgia*) type, and the *Calla* type. More than fifty types of air leaves are given, among which the following may be noted, so as to illustrate the method of the author: the violet type of shade leaf, the *Trientalis* type (wedge-shaped at base), the *Taraxacum* type of rosette leaves, the *Ipomoea* type of liana leaves, the *Cyclamen* type (reddish beneath), the *Begonia* type of velvety leaves, the *Ficus* type of gutter-pointed (dripping) leaves, the *Populus* type of trembling leaves, the *Allium* type of tubular leaves, the *Phragmites* type of weather-vane leaves, the conifer type of needle leaves, the *Eucalyptus* type of profile leaves, the grass type of involute leaves, the *Gnaphalium* type of hairy leaves, nyctitropic leaves, the *Mesembrianthemum* type of thick leaves, the *Carduus* type of spiny leaves, the *Drosera* type of insectivorous leaves. In each case there is a detailed description of the leaf type under consideration, together with a discussion of the ecological advantages of the type. The plants which illustrate the types are given in considerable detail.

Part III considers the same material, but the arrangement is by plant families and genera. Part IV considers the protective adaptations of young

² HANS GIRG, A., *Phyllobiologie nebst Uebersicht der biologischen Blatttypen von ein-und-sechzig Siphonogamenfamilien*. 8vo. pp. xiv+486. *figs.* 40. Leipzig: Gebrüder Borntraeger, 1903. *M*₁₂.

leaves, and twelve types are recognized and discussed. The concluding chapter contains a summary and some concluding remarks.

As might be supposed the author inclines to teleological views, holding that plant structures harmonize with their environment and even tend to become modified in advantageous ways. The volume will have somewhat the function of an encyclopedia, and it is therefore to be regretted that there is no index to genera.—H. C. COWLES.

MINOR NOTICES.

A REVISED EDITION of COULTER'S *Plant Structures*,³ an elementary text-book of plant morphology, has appeared, the first edition having been published in 1899. There are numerous changes that deal with misstatements, illustrations, changed points of view, and recent discoveries so far as these have to do with the purpose of so elementary a book. Such subjects as mycorrhiza, the development of the sporophyte of bryophytes, and the endosperm of angiosperms have been rewritten, and the topic of "double fertilization" introduced.

HELEN EASTMAN⁴ has written a fern book for amateurs, which is intended to be "an illustrated field-book that shall be concise, inexpensive, and adapted to the needs of the beginner." The photographs for the plates are said to have been "produced by an entirely original process." The general purpose of such books is to be commended, in so far as they stimulate interest in plants or help to make observation somewhat definite. Doubtless the present book will serve its purpose well in New England.—J. M. C.

ATKINSON⁵ has published an outline of his lectures on plant ecology as delivered at Cornell University and they will be of value to all teachers who give ecological courses or who introduce ecological features into general courses. After general lectures on the plant organization, plant organs are considered, then ecological factors, vegetation types, migration. Several lectures on the various formations or societies conclude the series.—H. C. COWLES.

NOTES FOR STUDENTS.

HITCHCOCK,⁶ in a short address on the control of sand dunes in the United States and Europe, gives an account of the European methods of dune control, and makes suggestions for similar work in this country.—H. C. COWLES.

³ COULTER, JOHN M., *Plant Structures*. Second edition revised. 12mo. pp. ix+348. *figs.* 289. New York: D. Appleton and Company. 1904.

⁴ EASTMAN, HELEN, *New England ferns and their common allies; an easy method of determining the species*. 12mo. pp. xix+161. Boston: Houghton, Mifflin & Co. 1904.

⁵ ATKINSON, G. F., *Relation of plants to environment (or plant ecology)*. Outlines of course of lectures delivered in the Summer School of Cornell University 1903 and 1904. pp. 67. Ithaca Publishing Co., Ithaca, N. Y.

⁶ HITCHCOCK, A. S., *Controlling sand dunes in the United States and Europe*. *Nat. Geog. Mag.* 1904:43-47.